A Reference Architecture For Network-Centric Information Systems

Dr. Scott Renner
Mr. Ronald Schaefer
The MITRE Corporation
{sar,schaef}@mitre.org

Abstract

This paper presents the *C2 Enterprise Reference Architecture (C2ERA),* which is a new technical concept of operations for building information systems better suited to the NCW environment. The C2ERA is the technical architecture mandated by the Designated Acquisition Commander for C4ISR Enterprise Integration in the U.S. Air Force. The C2ERA contains two key ideas. Related activities and functions are gathered into a *C2 Node,* with a designated node manager responsible for delivering and sustaining an integrated capability to the user community. The development of mission functionality is separated from the system infrastructure. This infrastructure (and the responsibility for it) is divided into one part which must be the same across the enterprise, called the *Common Integrated Infrastructure,* and another part which may vary between C2 Nodes, called the *node platforms.*

1. Introduction

Network-centric warfare is about effective networking of the warfighting enterprise, leading to increased combat effectiveness. This "networking" involves much more than physical communication links between people and the information systems they use. Information systems used in NCW must also support effective networking in the information and cognitive domains. These systems must therefore work with each other to produce coherent information, fusing many separate facts into a "common picture" of the environment. The systems must also help their users work with each other to collaborate and synchronize operations. Finally, because we do not always know in advance precisely what information will be needed and what user collaborations must be supported, we require information systems that can be quickly changed as required.

In short, what users need are information systems that are both cohesive and flexible. In their ideal vision, users would like something which from their perspective appears as a single seamless system, doing exactly what they want done today, and easily changed to do what they will want done tomorrow. This presents a challenge to system developers. The old way of building systems produced "stovepipes" which might support the needs of its particular users, but which did not work well with other systems and were not at all easy to modify.

In this paper we will describe the challenges faced by the system developers, explain the shortcomings of the former development paradigm, and explain why the C2ERA is a superior technical approach for designing, acquiring and integrating the information systems of the NCW Enterprise.

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2. The C2 Enterprise Integration Problem

What the users want to have is completely transparent technology, integrated into a single perfect C2 information system. This ideal system would:

- Do exactly what they need today,
- Be easy to change into what they need tomorrow,
- Have all parts working together as a seamless whole, allowing users to do the same, and
- Be affordable, delivered on schedule, delivered on budget, etc.

We couldn't build that perfect system yesterday, nor can we build it today, and we don't have a plausible roadmap for ever building that system. The fundamental problem is complexity. Perfect integration would require too many people to comprehend too many details. Arranging the necessary group knowledge is beyond our capacity today, and in the foreseeable future.

It is therefore necessary to make a compromise, accepting imperfect integration to reduce the complexity to something manageable. The compromise in the past has been to partition the C2 enterprise into many separate systems, managed independently by separate program offices. Each program office built a system to satisfy the needs of its users alone. Each program office built the mission functionality desired by the users: things like air mission route planning tools, or air refueling capacity calculators. Each program office also built the system infrastructure they required: things the users do *not* desire, such as networks and database management systems, but which are needed to support the functionality the users *do* desire. Mission functionality and infrastructure were built and delivered as a single tightly integrated amalgamation, making it nearly impossible to deploy a subset of the mission functionality or to replace a subset of the infrastructure with new technology. The infrastructure implementations were highly optimized for a specific set of mission functions and a specific set of users, making it difficult for any other program to reuse the infrastructure platform. Technical architectures and management approaches used to acquire C2 systems were also organized and structured to support the production and sustainment of separate C2 systems.

In short, the past compromise approach built systems which met the needs of small user communities, but which were hard to change and hard to make work with other systems. This compromise does not fit well with NCW, which demands seamless and dynamic connectivity between people in the information and cognitive domains. As a result we see symptoms of interoperability problems:

- Hard to make new connections and exchange C2 information among separate C2 systems, since interfaces were specified by individual pair-wise agreements.
- Hard to administer groups of C2 systems, since each system was designed and configured independently.
- Hard to manage change in C2 systems and functions, since interfaces were optimized for specific configurations.

So our current acquisition approach and technical architectures are not going to be effective in delivering on the promise of NCW.

3. The C2ERA Solution

The C2 Enterprise Reference Architecture (C2ERA) was developed to address the issues associated with delivering C2 systems that can support NCW. It is a different, better compromise between integration and complexity, made possible by new and better information technology. Instead of a single grand integration covering the whole C2 enterprise, we follow a decentralized approach to integration, focusing on technical convergence on elements which are larger than individual programs but smaller than the whole. The two key ideas in the C2ERA are:

- Gathering related activities and functions into a *C2 Node,* with a designated node manager responsible for delivering and sustaining an integrated capability to the user community. A C2 Node[1] is a major operational element of the NCW Enterprise and comprises a collection of activities and functions which the operational community uses as a major warfighting component.

- Separating the development of mission functionality from the system infrastructure. This infrastructure (and the responsibility for it) is divided into one part which must be the same across the enterprise, and another part which may vary between C2 Nodes. Information exchange between nodes is specified by node independent mechanisms that enable loose coupling and provide least common denominator interfaces that all nodes can implement.

The C2ERA brings us closer to the NCW ideal. It improves cohesion by gathering together things that used to be separate: the related mission applications. It improves flexibility by separating things that used to be irretrievably mixed: the mission functionality and the infrastructure.

The C2ERA supplies a technical design pattern to program office, contractor and user architects and developers. Its goal is to guide and constrain key system integration and interoperability decisions. It describes the *partitioning, roles*, and *interfaces* among the three technical elements of the enterprise. The C2ERA describes an enterprise architectural plan, one that subscribes to common standards, identifies critical integration points, utilizes pervasive commercial technologies, reduces development risk and is based on a computing services approach.

The C2ERA distinguishes between integration and interoperability appropriately, and seeks to use each appropriately. Integration is the intimate technical junction of C2 systems for closely related functions. Interoperability is the discrete linkage and sharing of information among C2 systems across the entire NCW Enterprise.

The C2ERA is intended to support platform evolution and technology insertion. Given the change and flexibility implications of NCW, identical solutions across the enterprise will

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[1] This usage of the term "node" is slightly different from the DoD Architecture Framework OV2 "Operational Node Connectivity Description" in that OV2 nodes are defined for operational reasons based on current or past CONOPS with no other criteria.

generally be impractical and non-optimal. C2 systems must be loosely coupled so that the triad of systems, organizations and processes can evolve and change rapidly.

The problems of semantic agreement and data management are not addressed by the C2ERA. It does not require data integration, database consolidation, or the designation of "authoritative sources" of data. We understand that these activities must happen as part of enterprise integration, but they are out of scope for the C2ERA.

4. Changing How We Organize Acquisition – The C2 Node Approach

A C2 Node is a collection of applications and infrastructure that is implemented to execute a set of operational capabilities. C2 Nodes can be treated as "black boxes" at the Enterprise level. This allows for a high degree of flexibility to the individual C2 systems developers and allows each C2 Node to evolve independently. C2 Node boundaries are defined for operational reasons and as strategically selected integration points to implement cross-mission and cross-capability integration. By intension, a C2 Node is a cohesive weapon system used by a collection of people to perform capabilities. It is not constrained to current operational practices. In order of importance, a good C2 Node:

- Displays *operational cohesion:* it serves a group of users who need to collaborate closely to perform their missions.

- Displays *implementation cohesion:* it collects and integrates mission applications which must work together seamlessly to support the users. Integration efforts proceed with identifying functional interactions and inter-exchanges that necessitate application level integration. This is as opposed to a random or system vendor driven application approach.

- Displays *infrastructure cohesion:* it collects mission applications which can be implemented using the same "C2 Node Platform" infrastructure. We want to avoid grouping applications with wildly different infrastructure needs.

The best ways to map capabilities to C2 Nodes will be through an iterative process, a co-evolution of technology, doctrine, and organization. With the current operational and technology constraints, C2 Nodes will be something akin to an OPFAC. Below this level the Node Manager

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**Attributes of the C2 Node as a Weapon System**

- Defined operational role as an element of the NCW Enterprise
- Single overall acquisition manager with responsibility and authority
- Optimized as an entity across all the system components
- Integrated components within the weapon system
- Training as an integral component, including tools, simulators, etc. as appropriate
- Significant test & validation process prior to deployment
- Complete DOTMLPF analysis developed prior to deployment
- Boundaries of valid usage established prior to deployment

is responsible for "Nodal" Integration. He or she is responsible for reducing the system administration burden, integrating functions within the C2 Node and across domains and providing a cost effective nodal infrastructure to system developers. He or she is also responsible for coordinating with other node managers and the Enterprise Manager. In this way there are far fewer integration points and there is a person responsible for each of them.

5. Changing How We Build Systems – Separating Functionality and Infrastructure

The second element of the C2ERA approach is to separate the mission functionality from the underlying IT infrastructure. Most programs will now build mission functionality that rides on and integrates with infrastructure components built and supported by other programs. By this partitioning into a layered approach, mission function oriented programs can focus on satisfying warfighter requirements, infrastructure programs can focus on satisfying mission function requirements, and we can avoid excessive coupling between functionality and infrastructure.

We believe it is necessary to make one further separation, dividing the infrastructure into one part which must be the same across the enterprise, and another part which may vary between C2 Nodes. The resulting architecture is shown in the following diagram.
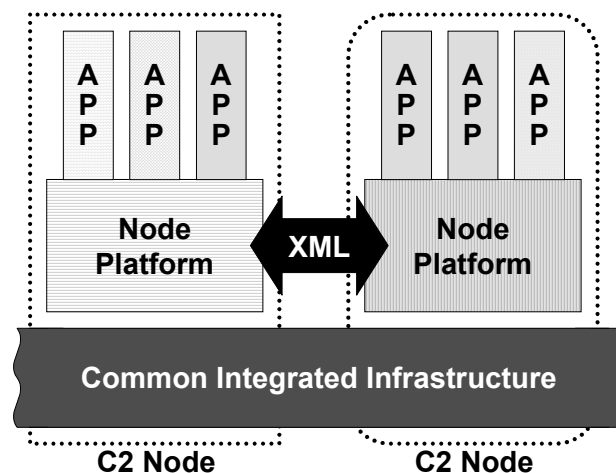
5.1 Why the Infrastructure Must Be Divided

A "one size fits all" infrastructure is not practical for the entire C2 Enterprise. Such an infrastructure would be difficult to build, since the range of requirements would be large. It would be difficult to evolve, since all the nodes would have to be modified as the infrastructure changed. It would be virtually impossible to optimize the infrastructure across the enterprise. For this reason we placed part of the infrastructure under the control of the node manager. This is the node platform. The C2ERA specifies a list of services (available in [1]) that must be provided by the node platform; implementation choices – usually between COTS products – are up to the node manager.

However, node managers cannot be in control of the entire infrastructure. In order for the enterprise to function, some basic capabilities must be the same across the enterprise. These are

called "enterprise services," and collectively they make up the *Common Integrated Infrastructure (CII)*. Node managers and application developers are required to use the CII services; separate implementations are forbidden.

5.2 Services That Belong in the CII

CII services are those that must be the same throughout the enterprise to avoid interoperability "seams" that would block the flow of information. CII services may be defined as those having the following properties:

- Enterprise essential – the enterprise won't work without it.
- Enterprise control – the rules for operation and administration must be the same; node managers have no autonomy (or limited autonomy).
- Enterprise scale – the service must be capable of handling every enterprise participant.
- Enterprise connectivity – it must be the same service throughout the enterprise. For example, the network communications service connects every enterprise participant; we don't have two or more disconnected networks.
- Enterprise content – the service returns the same result for the same request throughout the enterprise.

The *Domain Name Service (DNS)* is a good illustration of an enterprise service that belongs in the CII. DNS is the Internet service that translates network host names (e.g. "www.acc.af.mil") to network IP addresses (e.g. "131.6.12.199"). The properties of DNS that make it a good CII service are:

- DNS is a service. Mission applications call the service to translate host names; the service returns the network address.
- DNS is essential. For example, web browsers cannot work without DNS; they would have no way to resolve URLs.
- No one should build their own independent DNS. Everyone should use the service provided by the enterprise. (In this case, the "enterprise" is managed by the Internet Corporation for Assigned Names and Numbers, ICANN.)
- DNS must be available throughout the enterprise.
- It must be the same DNS, returning the same content, throughout the enterprise.
- The DNS content is created by many people.
- The rules for connecting DNS servers and for creating DNS content are the same throughout the enterprise.

5.3 Attributes of the Enterprise Services

We require certain technical, operational, and business properties in our enterprise services in order to make them dependable and easy to use. Enterprise services will always have a least-common-denominator service specification, one which makes the fewest possible assumptions about the node platform infrastructure. This avoids infrastructure coupling and preserves the

node manager's autonomy. The enterprise service provider will typically supply APIs, development tools, SDKs, etc. to support node platform and mission application developers. Key performance parameters are defined, including response times, reliability, security, availability, other "ilities" as well as standard certifications such as C4ISP, CTO, CON, etc. Enterprise services are managed and available 24x365. Each service has an on-going O&M commitment, provides cost, resource and licensing agreements.

6. Relationship of the C2ERA to the Global Information Grid

The C2ERA was initially developed by the Air Force as a way to provide a more detailed (design pattern) guidance to government program offices and system developers to ensure that an integrated enterprise vision as outlined in the Global Information Grid (GIG) architecture would be achieved.

C2ERA provides a layered structure that takes advantage of current commercial industry approaches to support network centric operations. It provides guidance to AF developers such that they can acquire and integrate enterprise level capabilities. The AF has shared the C2ERA with DISA, Army and Navy partners and has also offered this to the GIG V2 effort.

The GIG and the C2ERA are mutually beneficial and necessary. The GIG is a higher level definition of architecture vision to support NCW. The C2ERA is a necessary and more detailed design pattern for NCW and enterprise interoperability. Efforts should be taken in the future to ensure that these architectures evolve as companion documents.

7. Challenges

Adopting the C2ERA is more than just a change in technical direction and detail. The C2ERA approach changes some basic acquisition concepts:
- Integration, especially enterprise-level integration, takes work. Somebody has to do it. The C2ERA approach moves much of that work from deployment to development. Our current stovepipe C2 systems force the units setting up a C2 facility to do the detailed integration of the individual systems. C2ERA moves much of that responsibility to the Node Manager as part of the acquisition process.
- The role of the Node Manager introduces a new relationship. The requirement for individual C2 systems to be integrated into the node reduces the autonomy of the programs, since it can add dependencies on things the programs now control. It imposes constraints of complying with an externally provided infrastructure where programs are now free to choose their own infrastructure.

As the Air Force moves forward to adopt and institutionalize the C2ERA, the acquisition community needs to:
- Develop and mature enterprise acquisition processes to support enterprise-level analysis.
- Develop and mature processes and policies to empower the Node Manager.
- Engage the programs to identify capabilities that should be provided as enterprise services versus node platform components.

- Engage with industry to identify opportunities for standardization of node platform components.
- Identify program-specific solutions that can be evolved and expanded to satisfy enterprise requirements.
- Develop migration strategies for programs to move to enterprise solutions when they become available.

8. Conclusion

NCW requires new approaches to Enterprise Integration. For the NCW Enterprise to deliver on its promise, we need to deliver warfighter capabilities with "Enterprise Inside."

The Air Force C2ERA is a basic design pattern for NCW Enterprise Integration. It partitions the enterprise into Applications, Nodes and Common Infrastructure (CII) that is made practical by advances in IT technology. The resulting architecture provides a better compromise than a C2 system-centric approach, but is not perfection. It improves cohesion among things that need to work together, while reducing coupling among things that should change independently.

The C2ERA focuses on developing a small manageable set of integration points for the NCW Enterprise. These must allow information to flow efficiently while providing acquisition flexibility to incorporate the latest and ever-evolving technologies. Trying to manage at the Program level will not achieve this. C2 Nodes offer an intermediate integration activity that is a compromise between trying to integrate and manage a large number of constantly changing systems and trying to integrate by requiring that all development activities use the same products.

References

1. Air Force C2 Enterprise Technical Reference Architecture, Version 3.0, 1 December 2002.
   https://cao.hanscom.af.mil/documentation/C2_EnterpriseArch/C2ERA-RefArch-V3-0.doc

2. C4ISR Enterprise Directive 008, Technical Architecture for C4ISR Enterprise Integration, 13 January 2003.
   https://cao.hanscom.af.mil/documents/DED/CED008-13Jan03.pdf

3. Global Information Grid, DODD 8100.1, 19 Sept 2002, Enclosure 2

Appendix – A C2 Node / C2ERA Taxonomy

Capability	Something that gets done (operational)
Application	Something that gets built to execute a capability
Domain	Collection of similar capabilities which is convenient and useful for business purposes
C2 Node capability	Collection of capabilities with an intended operational result
C2 Node proponent	User reps that choose the collection of things done
C2 Node	Collection of applications & infrastructure that gets built to execute a C2 Node Capability
C2 Node manager	Manager for building & deploying a C2 Node
C2 Node platform	The infrastructure that supports a particular C2 Node
C2 Node admin	Manager for administering a C2 Node
C2 Node users	The people performing the C2 Node capabilities
C2 Facility	Location for executing capabilities
C2 Facility manager	Manager for the location
CII manager	Manager for building & deploying the CII
CII Cluster	That part of the CII that is deployed at a C2 Facility
CII Cluster operator	Manager for administering a CII cluster

A Reference Architecture for Network-Centric Information Systems

Dr. Scott Renner
sar@mitre.org

17 June 2003

M ITRE

C2 Enterprise Reference Architecture (C2ERA)
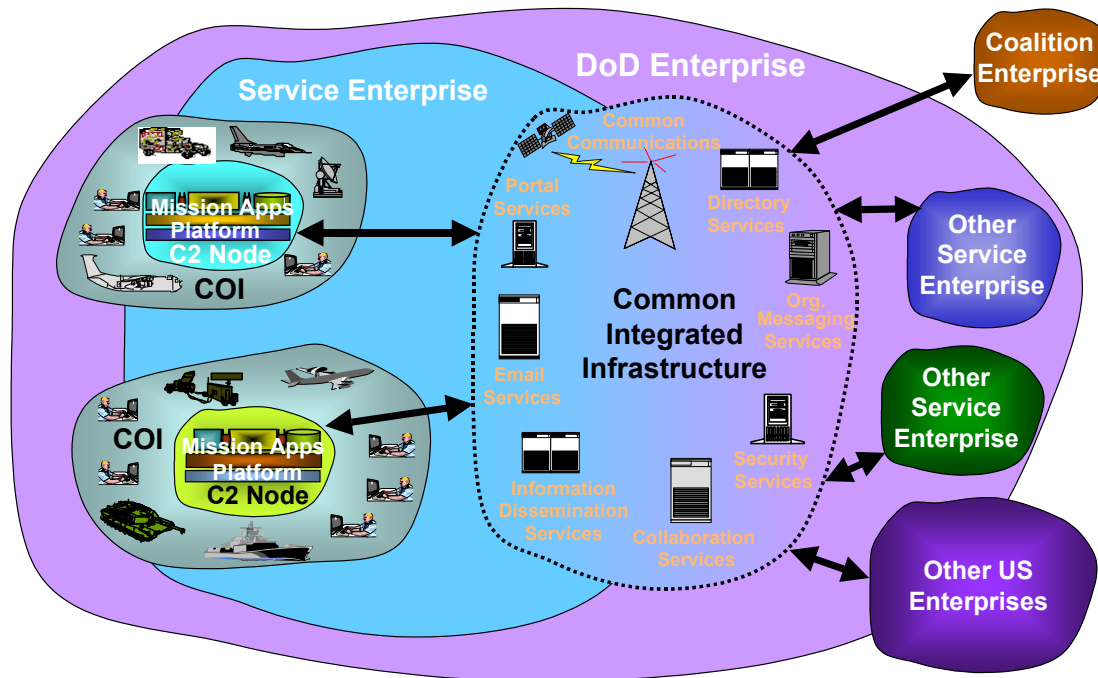
- **What problem does C2ERA try to solve?**

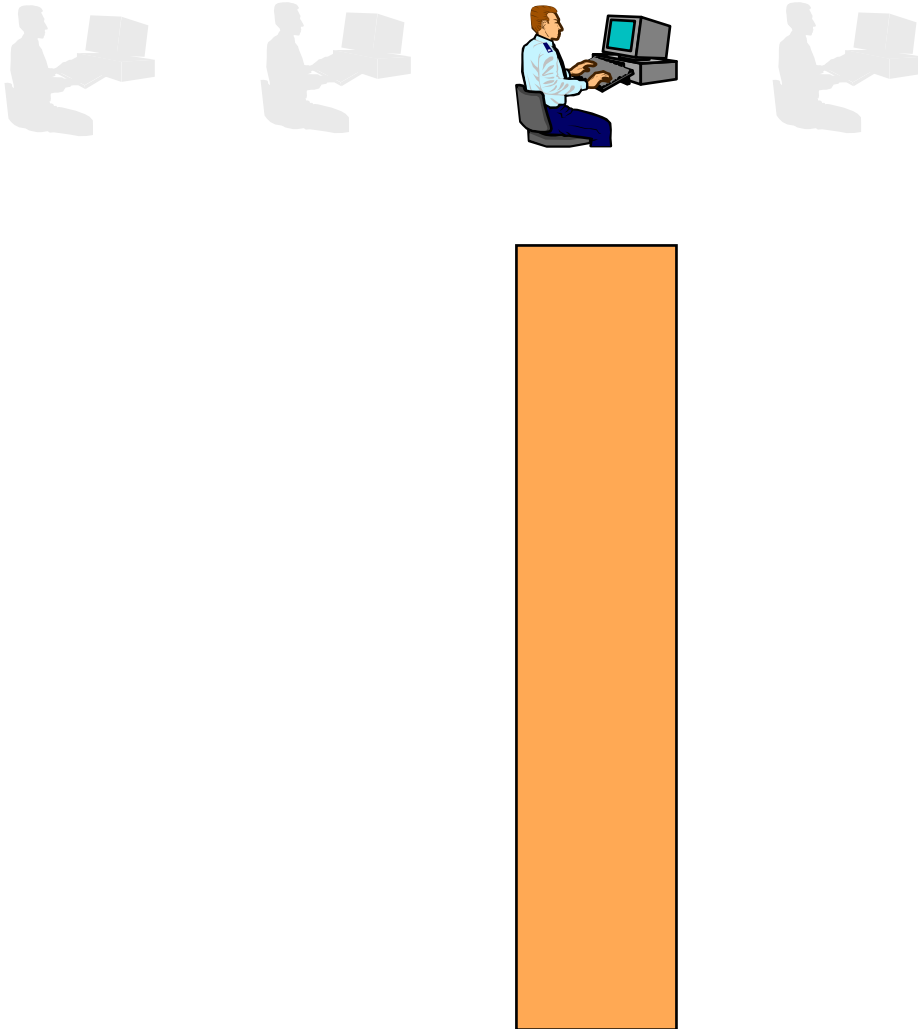- **What are the key aspects of the solution?**

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What The Users Want

- C2 users would like to have a single perfect C2 system
  - It does exactly what they need today
  - It's easy to change into what they need tomorrow
  - All users and all parts working together as a seamless whole
  - Affordable, on schedule, etc...

- We couldn't build that perfect system yesterday
  - And still can't today

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The Past Compromise

- **Instead, we organized the world into program offices that built separate C2 systems**

- **A program built a system for its users**

The Past Compromise
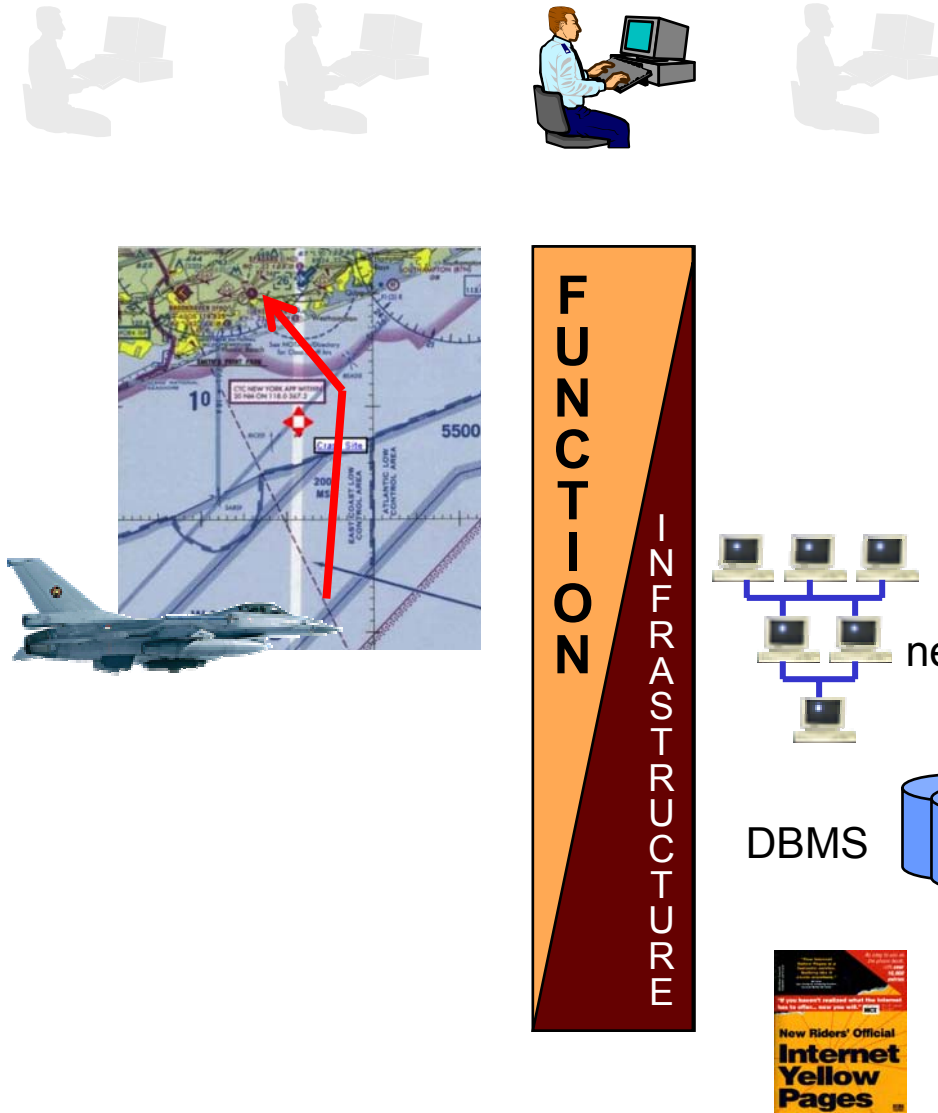
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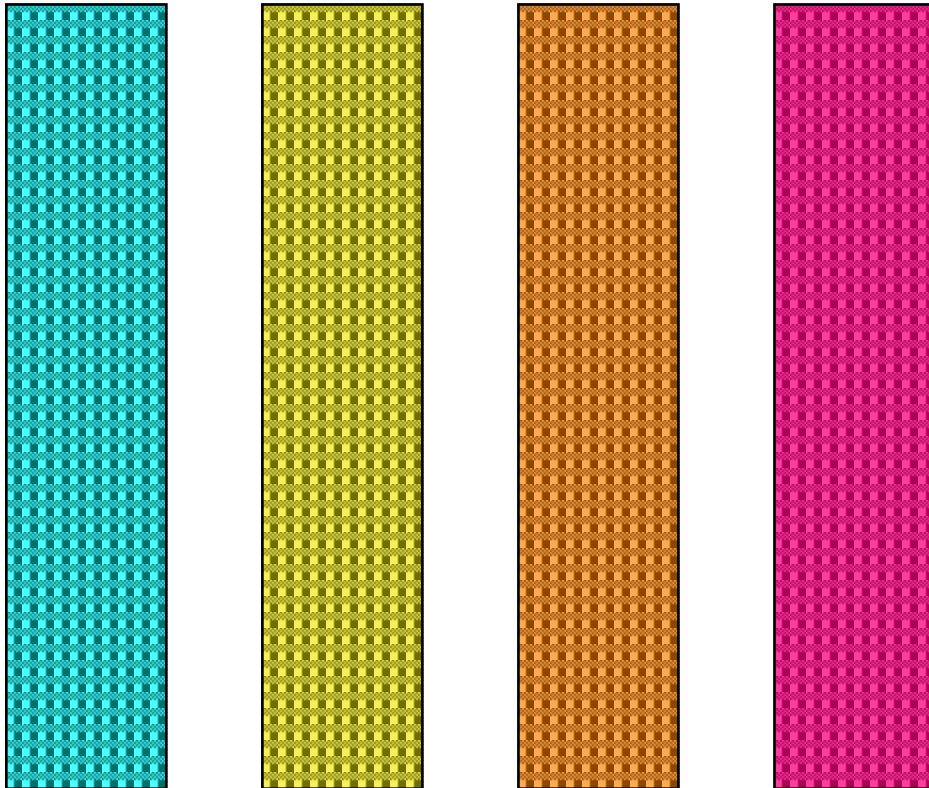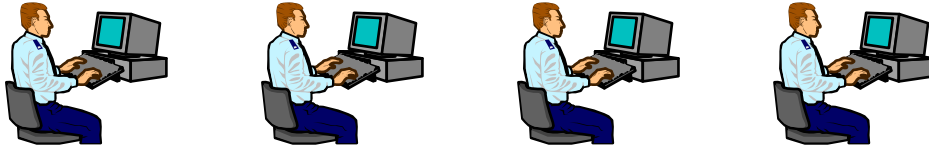
INFRASTRUCTURE

network

DBMS

directory

- **Instead, we organized the world into program offices that built separate C2 systems**

- **A program built a system for its users**
  - **All the mission functionality they wanted**
  - **All the infrastructure they needed**

M ITRE

The Past Compromise
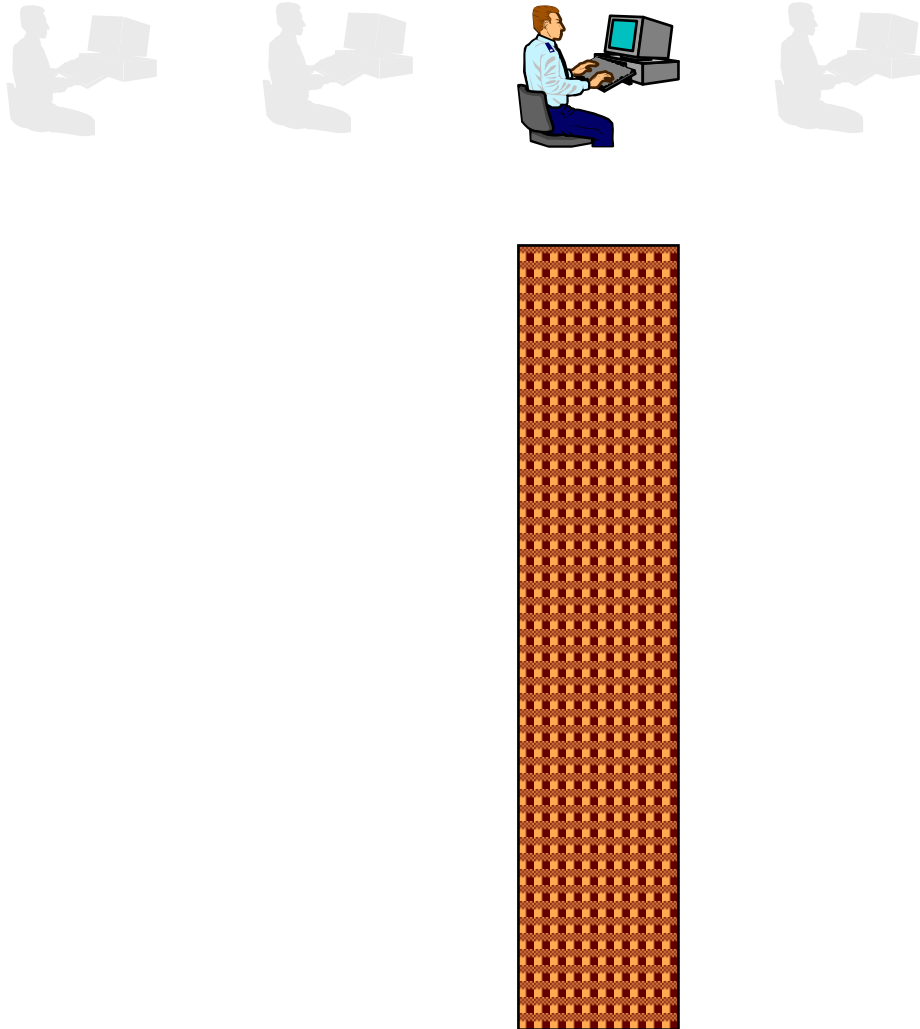
- **Instead, we organized the world into program offices that built separate C2 systems**

- **A program built a system for its users**
  - **All the mission functionality they wanted**
  - **All the infrastructure they needed**
 - **Delivered as a single amalgamation**

The Past Compromise

Hundreds of C2 systems...

- **Instead, we organized the world into program offices that built separate C2 systems**

- **A program built a system for its users**
  - **All the mission functionality they wanted**
  - **All the infrastructure they needed**
  - **Delivered as a single amalgamation**

- **And other programs built other systems for other users...**
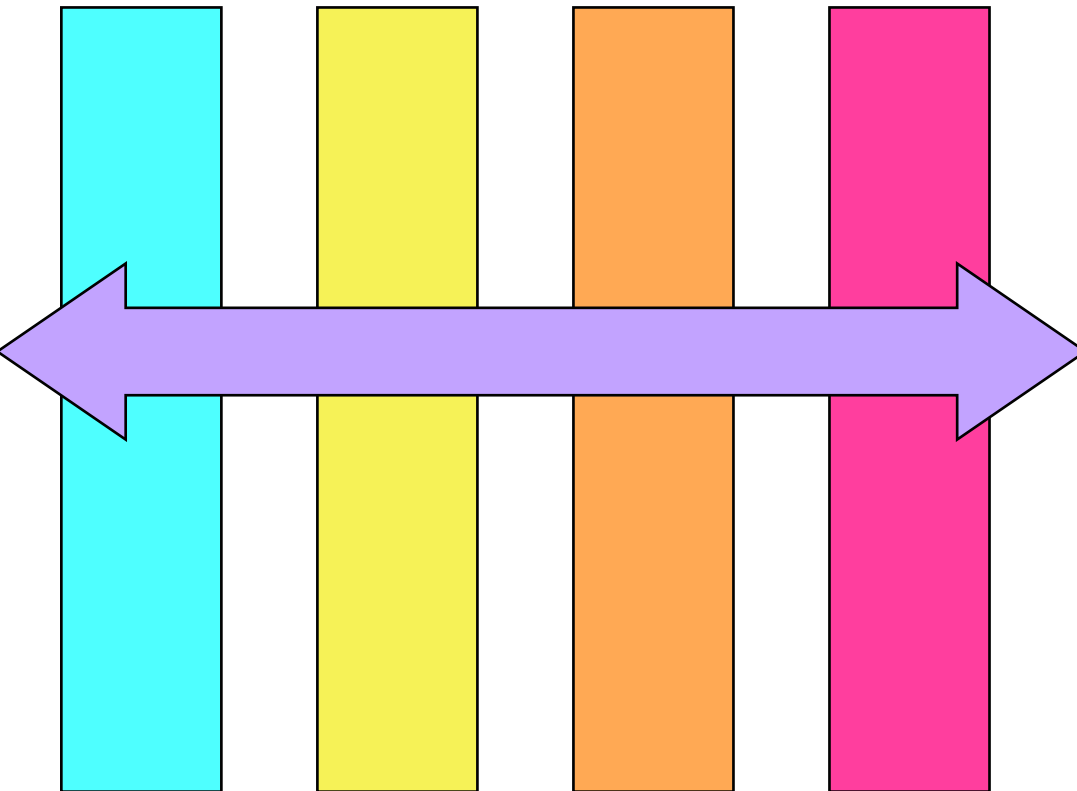
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A Forest Of Stovepipe Systems
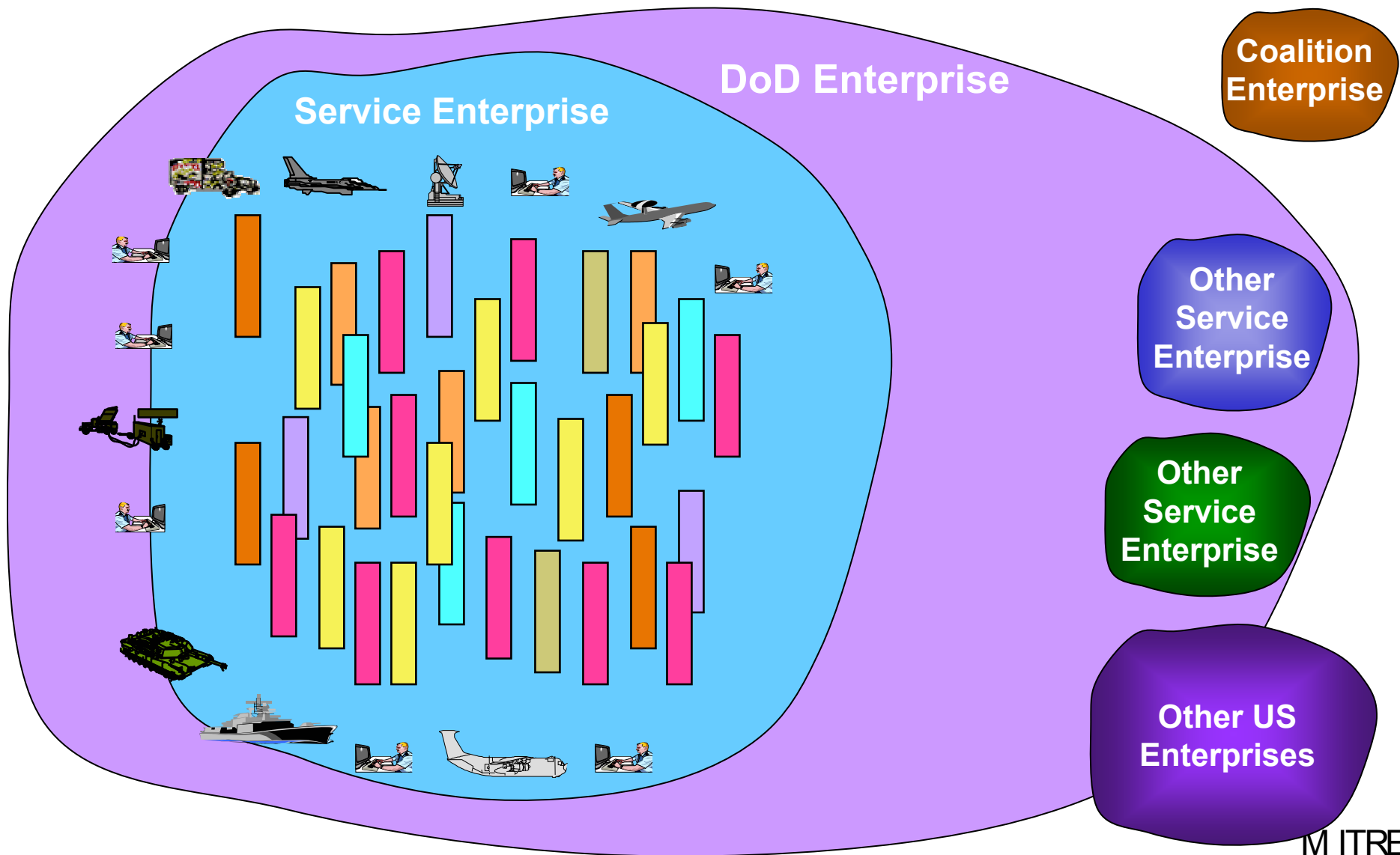
The C2 Enterprise Integration Problem
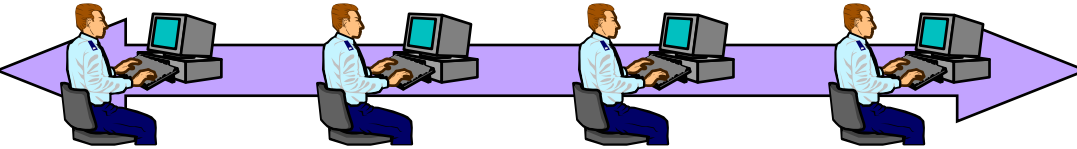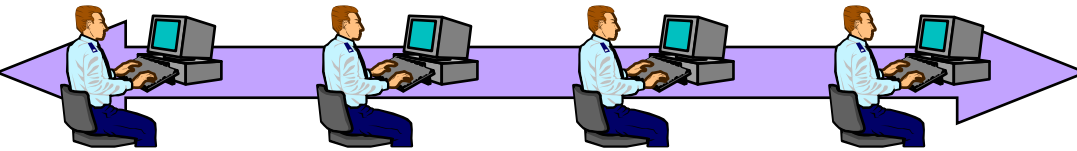

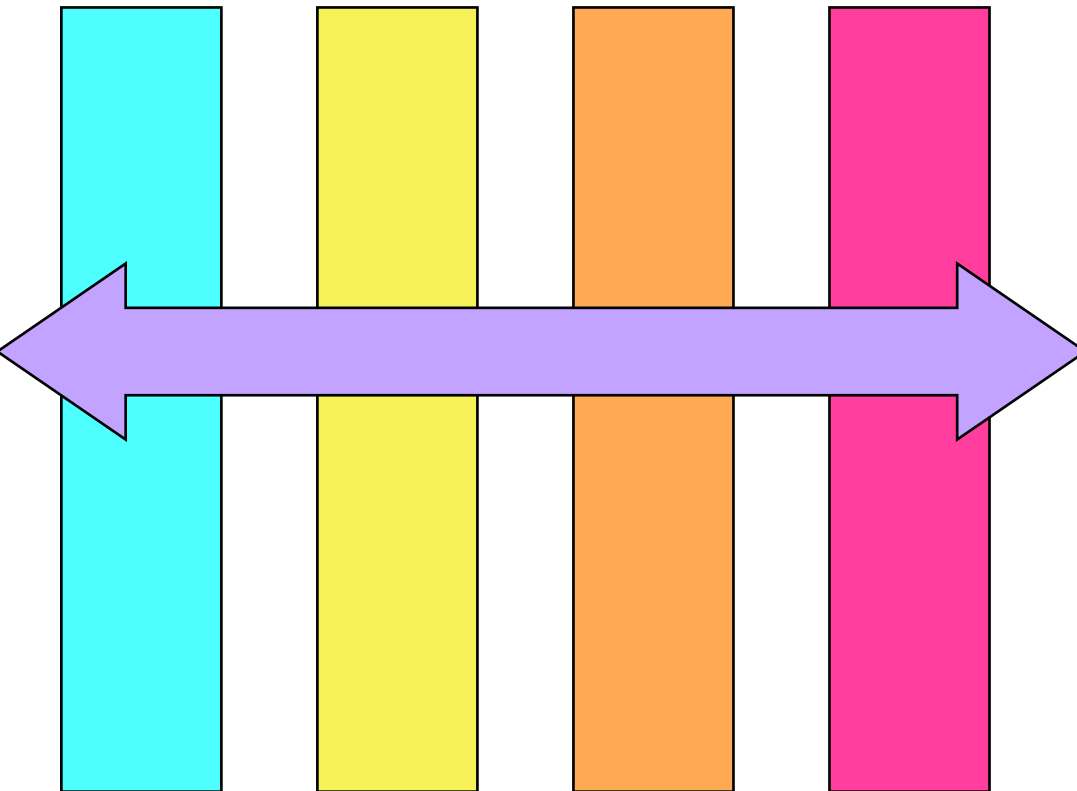
It's difficult for these people to work together

Because it's hard to make the systems they use interact with each other

Symptoms

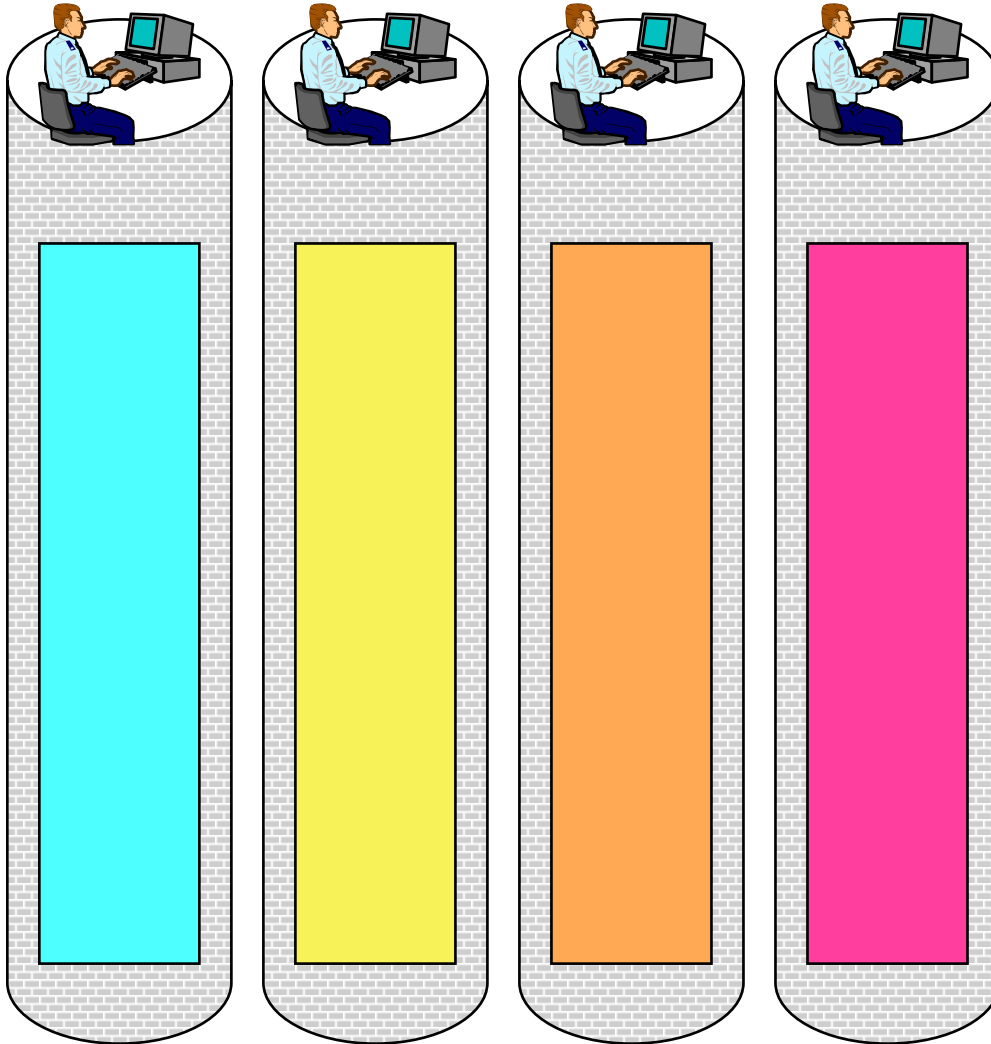- **Hard to connect separate C2 systems**
  - **Different infrastructures**

- **Hard to make systems exchange C2 information**
  - **Shared semantics are difficult to arrange**

- **Hard to administer groups of C2 systems**
  - **Each system needs its own sysadmin staff**

- **Hard to manage change in C2 systems and functions**
  - **Inflexible interfaces**
  - **Rigid infrastructure**

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The Result

Unhappy users

**Important C2 capabilities
that we can't afford,
or build at any price**

Inflexible, stovepipe systems

Co-evolution is impractical

Delay in achieving NCW

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The C2 ERA Solution

- **Change how we organize C2 enterprise acquisition**
  - **Manage programs and systems as components of *C2 Nodes***

- **Change how we build the individual C2 applications**
  - **Don't build separate infrastructure for each system**
  - **Deliver applications that share a *C2 Node Platform* and a *Common Integrated Infrastructure***

Two different changes…
both built around the same *C2 Node* concept

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First Change: How We Organize Acquisition
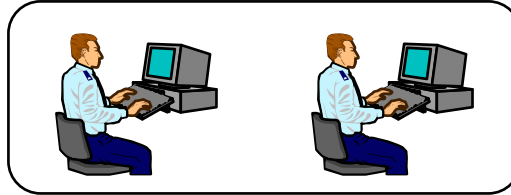

Begin with users that must cooperate closely

Program offices build the applications that those users need

C2 Node Manager ensures that those applications are seamlessly integrated

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First Change: How We Organize Acquisition

Begin with users that must cooperate closely

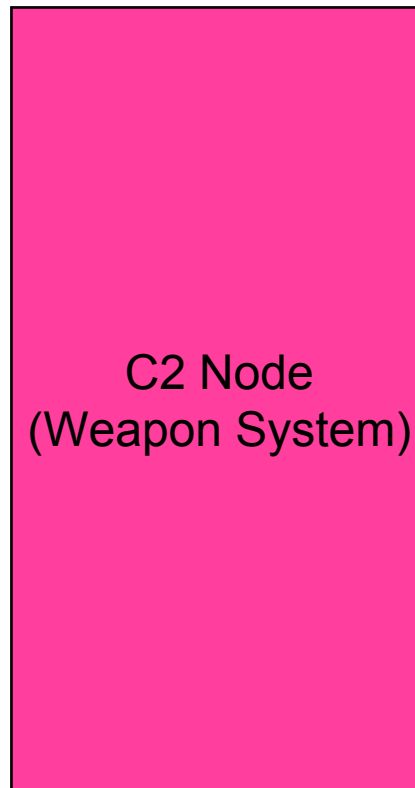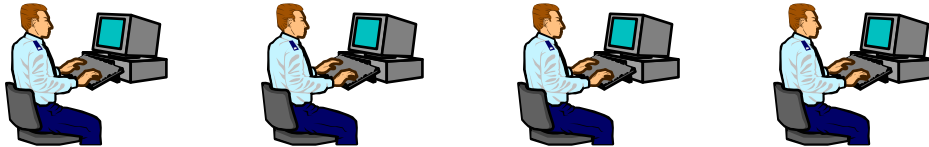**Program offices** build the applications that those users need

C2 Node Manager ensures that those applications are seamlessly integrated

And delivers integrated applications as a cohesive C2 weapon system

C2 Node
(Weapon System)

MITRE

First Change: How We Organize Acquisition

Repeat for each distinct *C2 Node User Community* and each *C2 Node Capability*
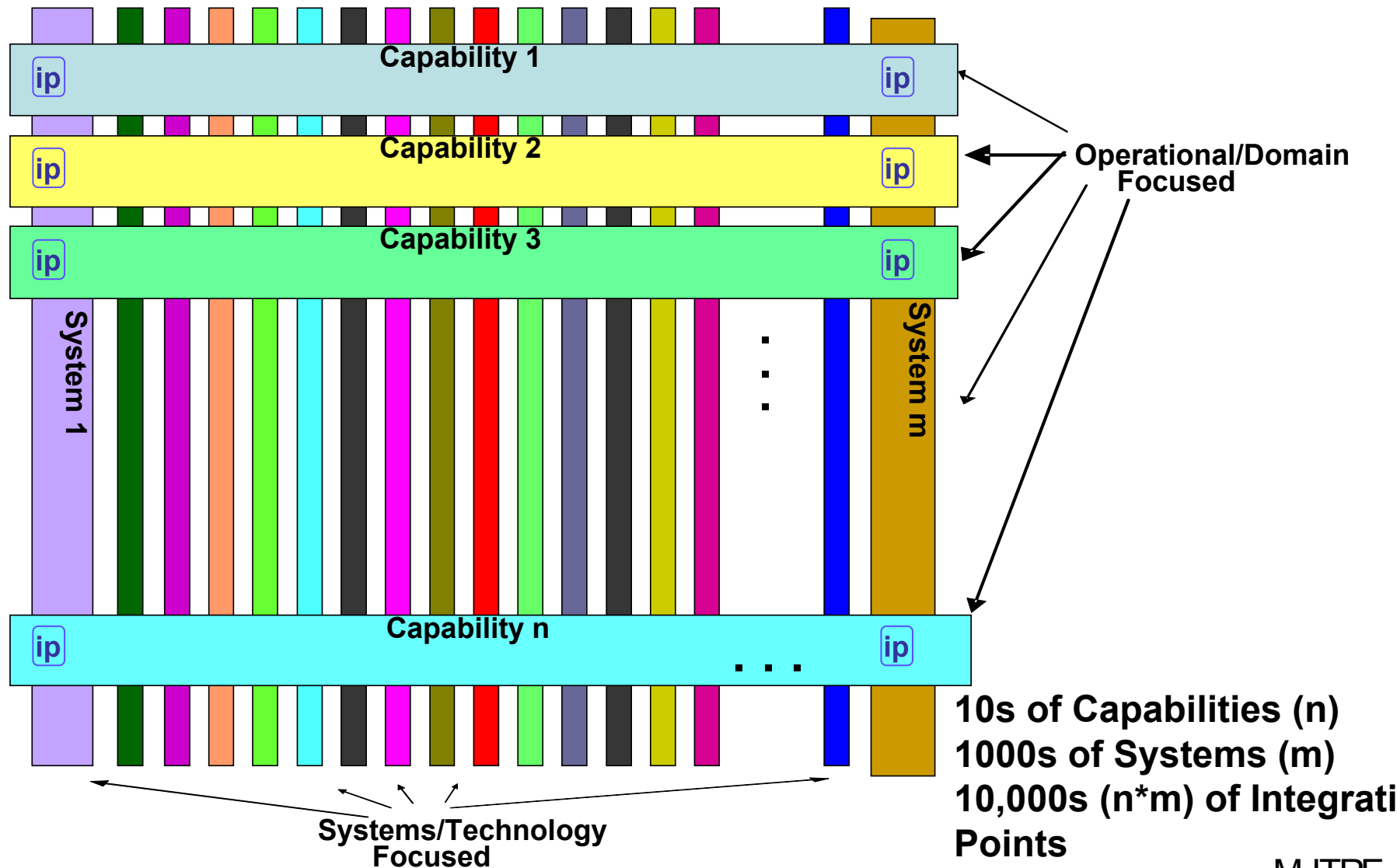
C2 Node
(Weapon System)

C2 Node
(Weapon System)

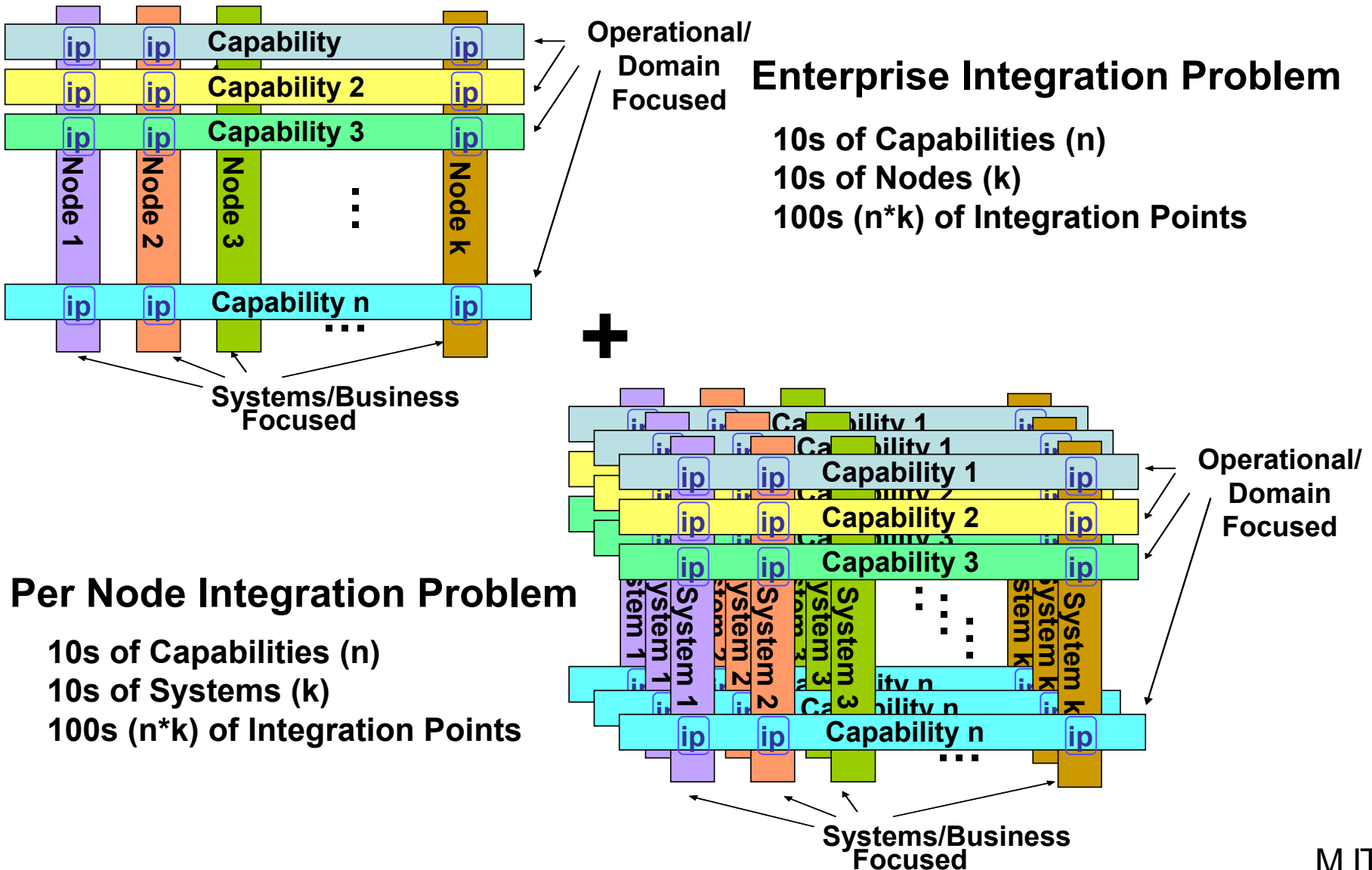**Operational concerns dominate the selection of C2 Node boundaries...**

But technical concerns can't be ignored – because you must be able to *build* the "weapon system" you *want*

Result: *Many* fewer C2 Nodes… better, but still not good enough

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Today's Enterprise Integration Problem

10s of Capabilities (n)
1000s of Systems (m)
10,000s (n*m) of Integrati
Points

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C2 Node Impact on Enterprise Integration

Operational/ Domain Focused

Enterprise Integration Problem

10s of Capabilities (n)
10s of Nodes (k)
100s (n*k) of Integration Points

Systems/Business Focused

+

Per Node Integration Problem

10s of Capabilities (n)
10s of Systems (k)
100s (n*k) of Integration Points

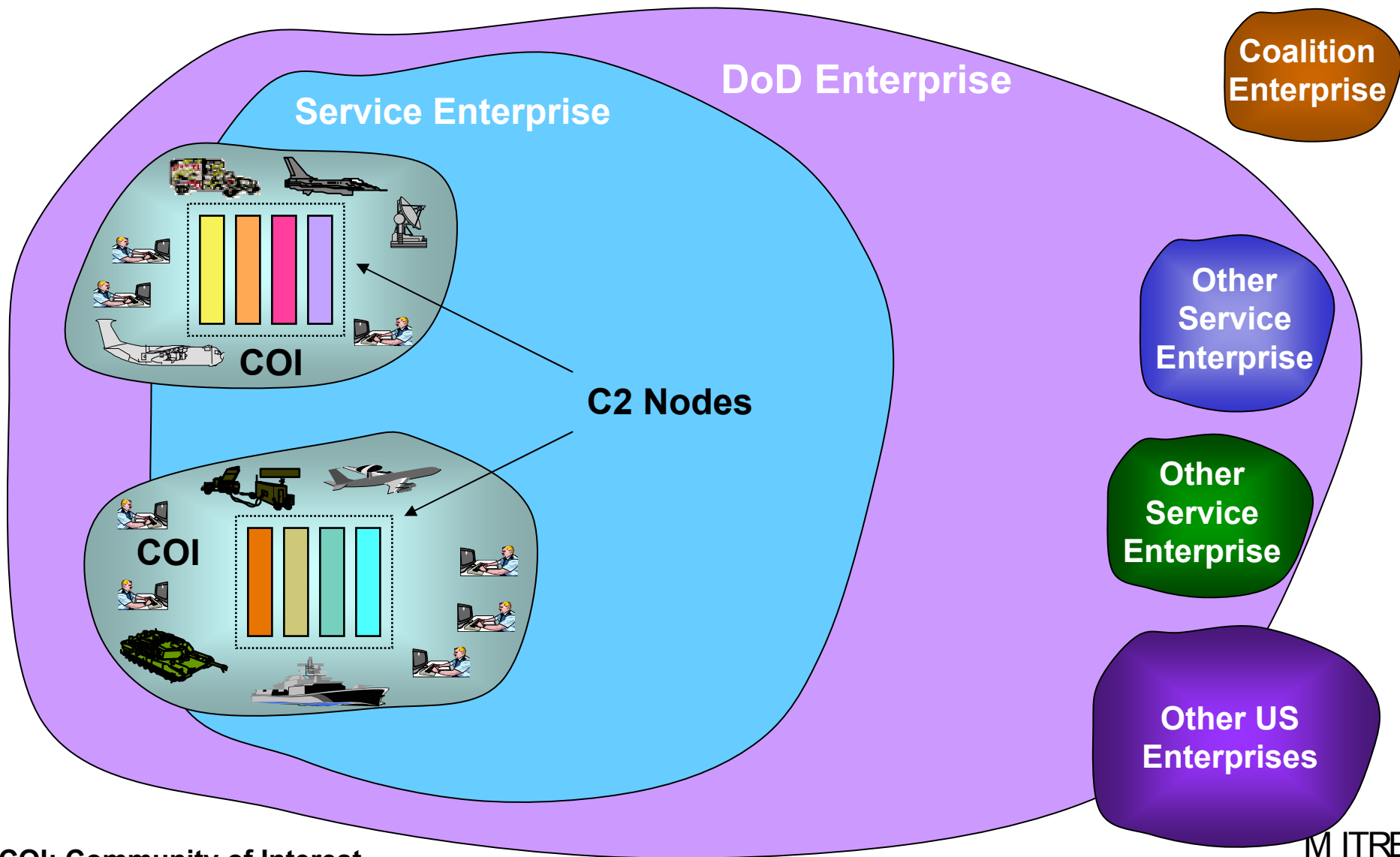**Operational/ Domain Focused**
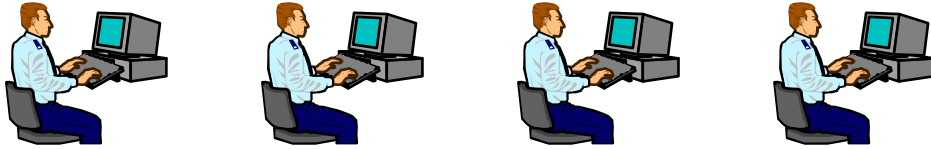
Systems/Business Focused

MITRE

C2 Nodes

- **C2 Node:** *A set of materiel and non-materiel solutions that is managed as a weapon system[and provides warfighting capability at a specific location or set of locations.*

- **C2 Nodes are defined as strategically selected integration points to implement cross-mission and cross-capability integration**

- **Well chosen C2 Nodes will:**
  - **Display <u>operational cohesion</u>: Have users who need to collaborate closely to perform their missions**
  - **Display <u>implementation cohesion</u>: Collect and integrate mission applications which must work together seamlessly to support the users**
  - **Display <u>infrastructure cohesion</u>: Collect mission applications which can be implemented using the same "C2 Node Platform" infrastructure**

Users and Systems Collected Into C2 Nodes

DoD Enterprise

Coalition Enterprise

Service Enterprise

COI

C2 Nodes

COI

Other Service Enterprise

Other Service Enterprise

Other US Enterprises

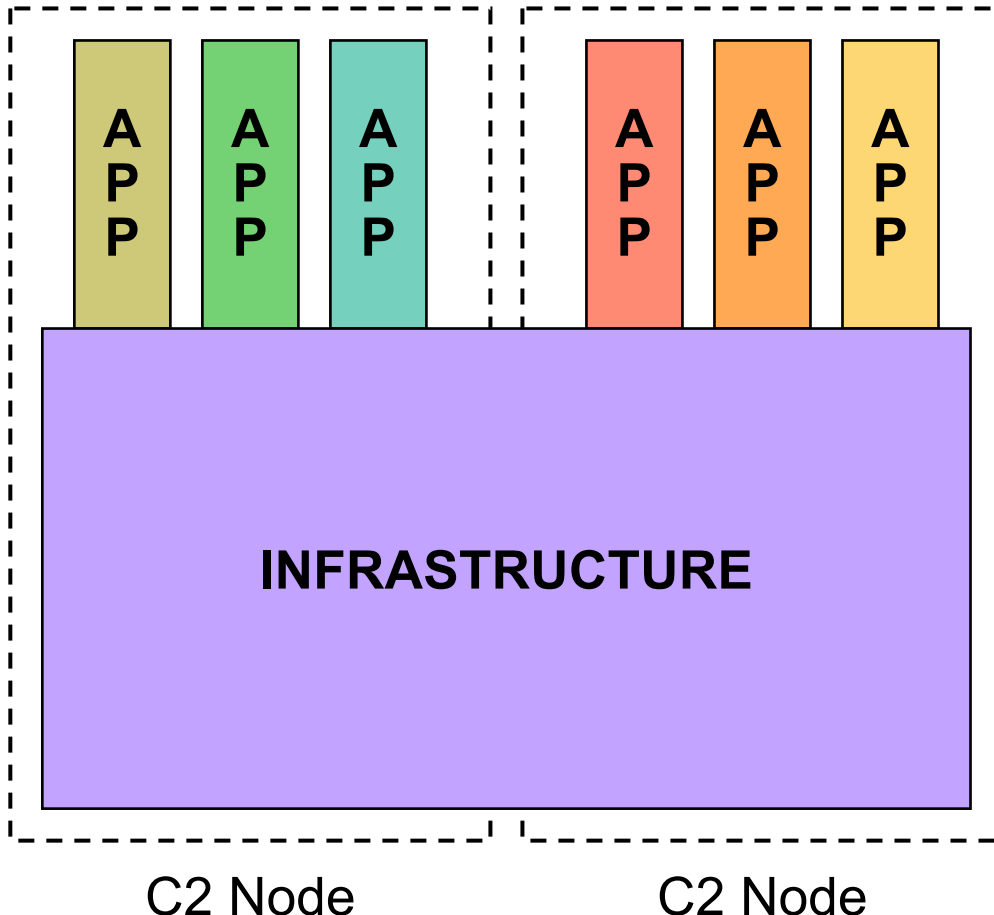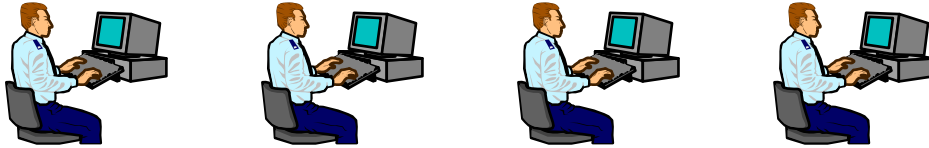**COI: Community of Interest**

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Second Change: How We Build

Most program offices
build mission applications

Applications and
infrastructure are
CLEARLY SEPARATED…
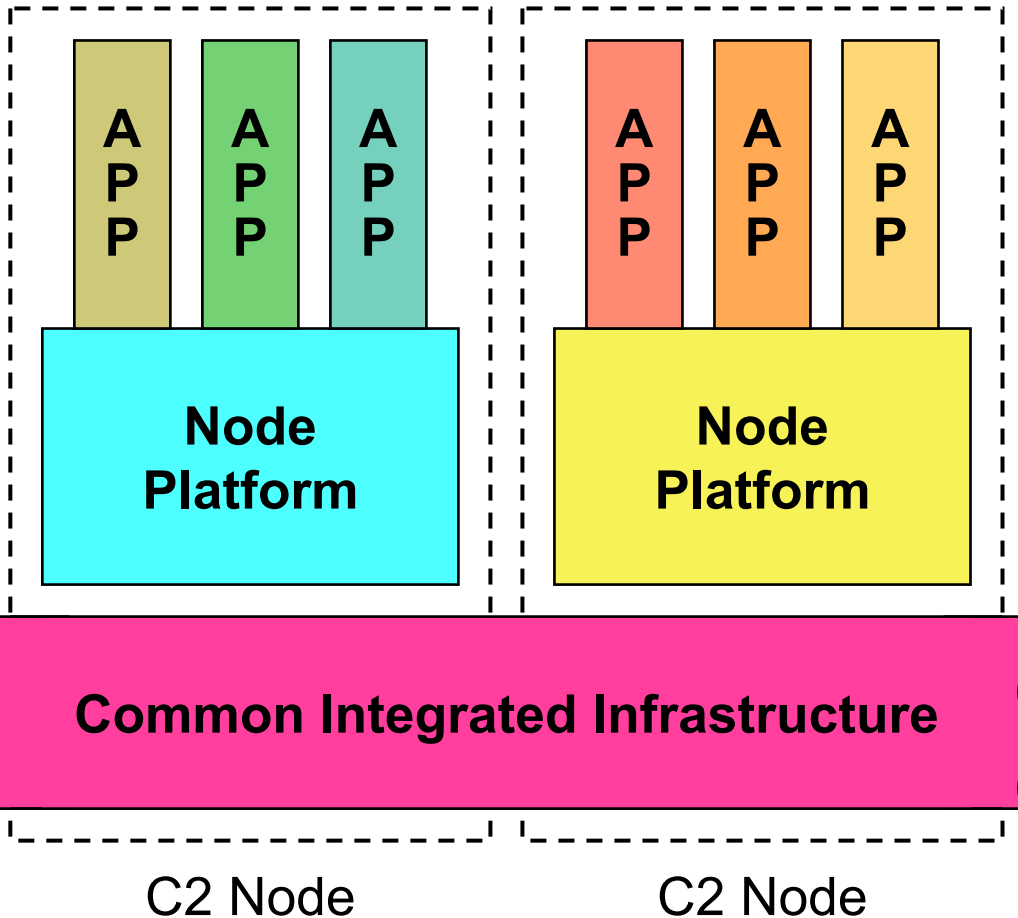– Apps use infrastructure
– Ideally nobody builds both

A few program offices
build infrastructure

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Second Change: How We Build

- **Programs build mission applications to satisfy user requirements**

- **Those applications must use the infrastructure specified, built, and operated by somebody else**

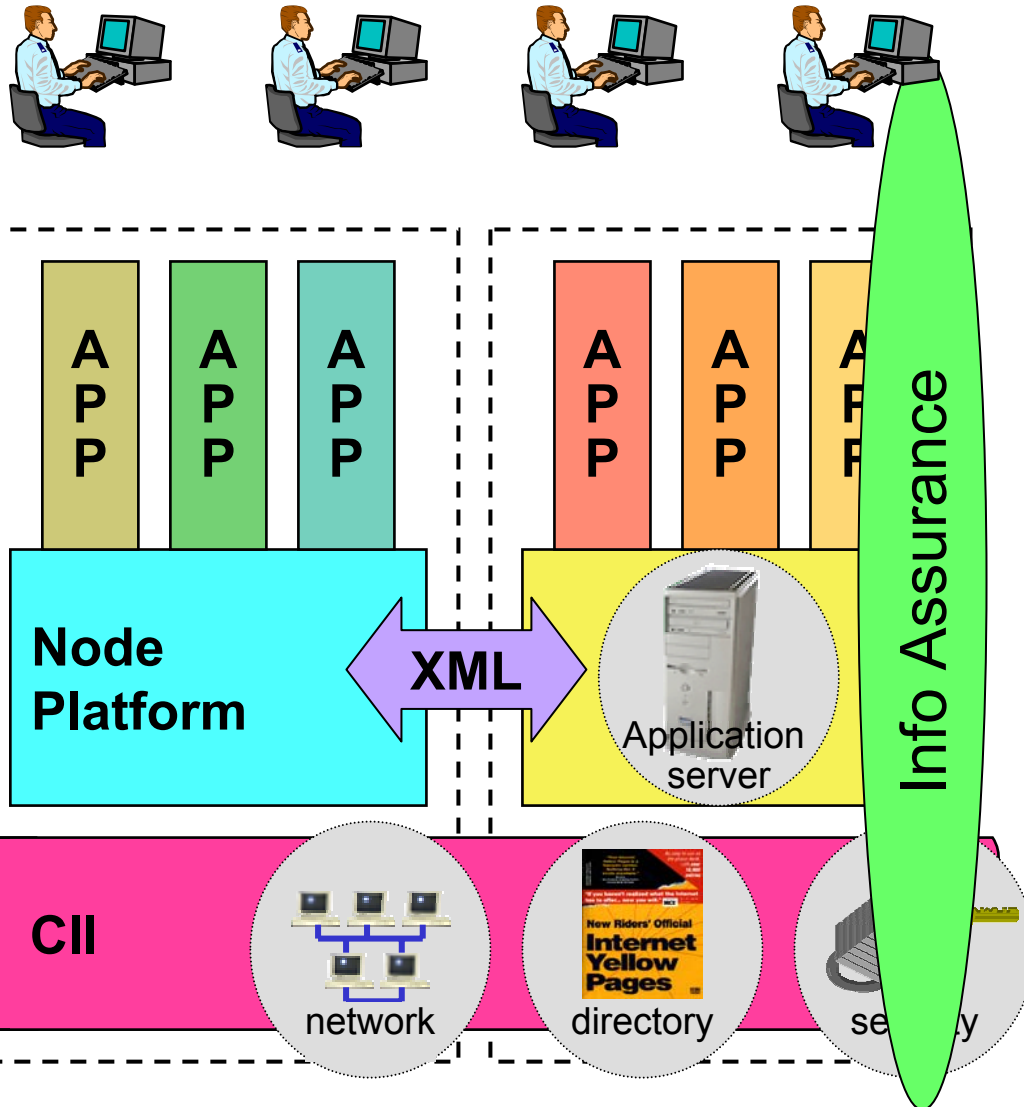- **We can't build a single infrastructure that does everything for everyone, so...**

APP **APP** **APP**   **APP** **APP** **APP**

INFRASTRUCTURE

C2 Node   C2 Node

Second Change: How We Build

APP APP APP

APP APP APP

Node Platform

Node Platform

Common Integrated Infrastructure
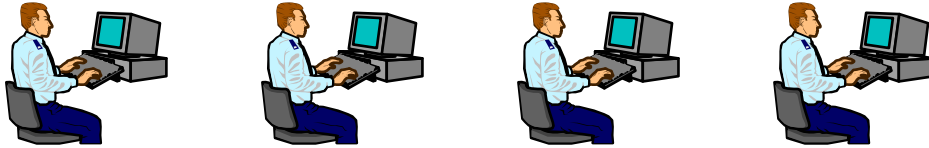
C2 Node   C2 Node

- We split the infrastructure into two parts

- One part is different for each node
  - The C2 Node Platform is chosen by each Node Manager

- One part is the same for the entire C2 Enterprise
  - The Common Integrated Infrastructure is managed "like a node"

- The C2 Enterprise Reference Architecture describes the services in each part

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Information Technology Overview

APP   APP   APP   APP   APP   APP

Node Platform   XML   Application server

Info Assurance

CII   network   directory   security

- **Global Grid – seamless, enterprise network**
- **Enterprise directory of people, services, etc.**
- **Component frameworks – a way to build applications**
- **XML Web Services – how C2 Nodes interact**
- **Enterprise info assurance services**
- **Info Assurance constraints across the architecture**

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Why Divide The Infrastructure?
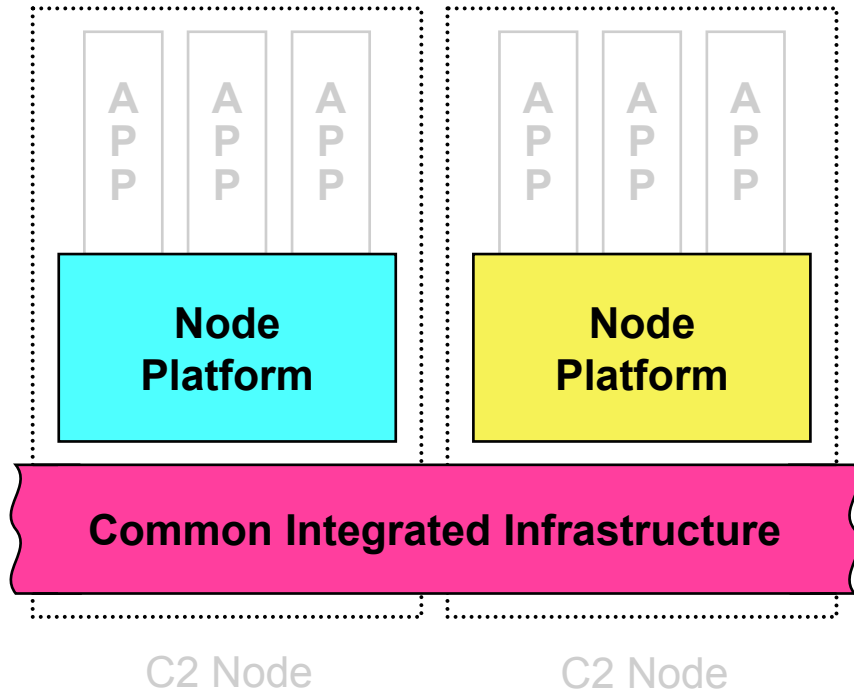
- **Why have Node Platforms? Why isn't everything in the CII?**
  - **Dependencies between nodes**
  - **Hard to change and evolve**

- **Why have the CII? Why isn't everything in Nodes?**
  - **Some things _must_ be the same**

- **What makes a service belong in the enterprise-level CII?**
  - **Enterprise essential**
  - **Enterprise control**
  - **Enterprise scale**
  - **Enterprise content or connectivity**

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CII Example: Domain Name Service (DNS)

`www.acc.af.mil`

Service Request from Anywhere

Q: What is the IP address of `www.acc.af.mil` ?

A: 131.6.12.199

DNS

Common Integrated Infrastructure

DNS belongs in the CII because:

- **DNS is a service**

- **DNS is essential**

- **Nobody builds their own DNS**

- **DNS is available everywhere**

- **It is the same DNS everywhere**

- **The DNS content is created by many people**

- **All this works because the rules for connecting DNS servers and for creating DNS content are the same for the whole enterprise.**

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DNS Is More Than Software

www.acc.af.mil

Service Request from Anywhere

Q: What is the IP address of `www.acc.af.mil`?

[no response]

DNS software

DNS

Common Integrated Infrastructure

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DNS Is More Than Software + Hardware

`www.acc.af.mil`

Service Request from Anywhere

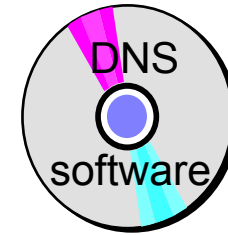**Q: What is the IP address of `www.acc.af.mil` ?**

A: unknown

DNS software *and*

DNS

Common Integrated Infrastructure

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DNS Is People, Process, and Technology

www.acc.af.mil

DNS software

and

and

Service Request from Anywhere

I control the .mil domain

Q: What is the IP address of
www.acc.af.mil
?

A:
131.6.12.199

I control af.mil

I control acc.af.mil

DNS

Let www.acc.af.mil = 131.6.12.199

Common Integrated Infrastructure

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Result of the Two Changes

APP APP APP

Node Platform

APP APP APP

Node Platform

Common Integrated Infrastructure
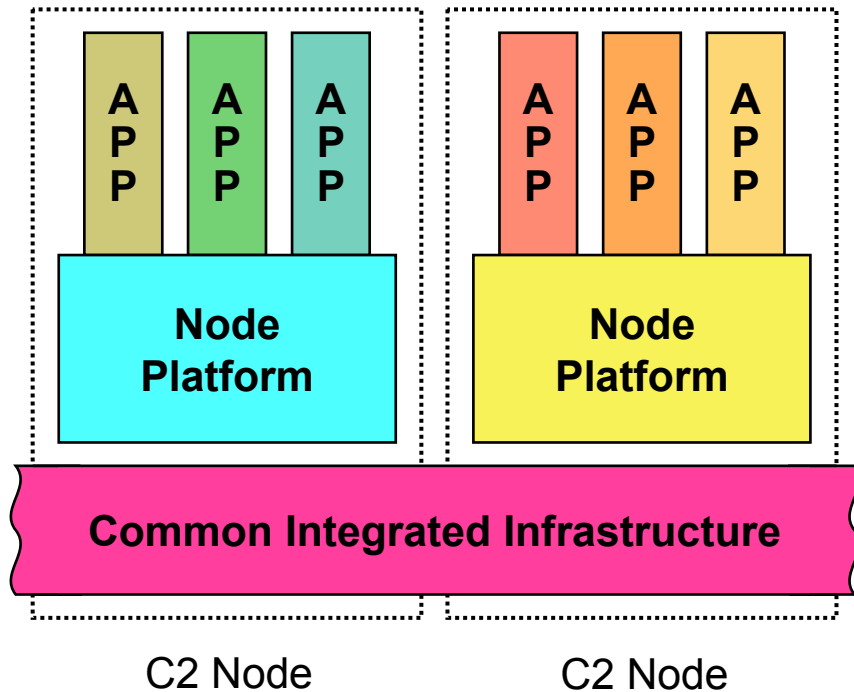
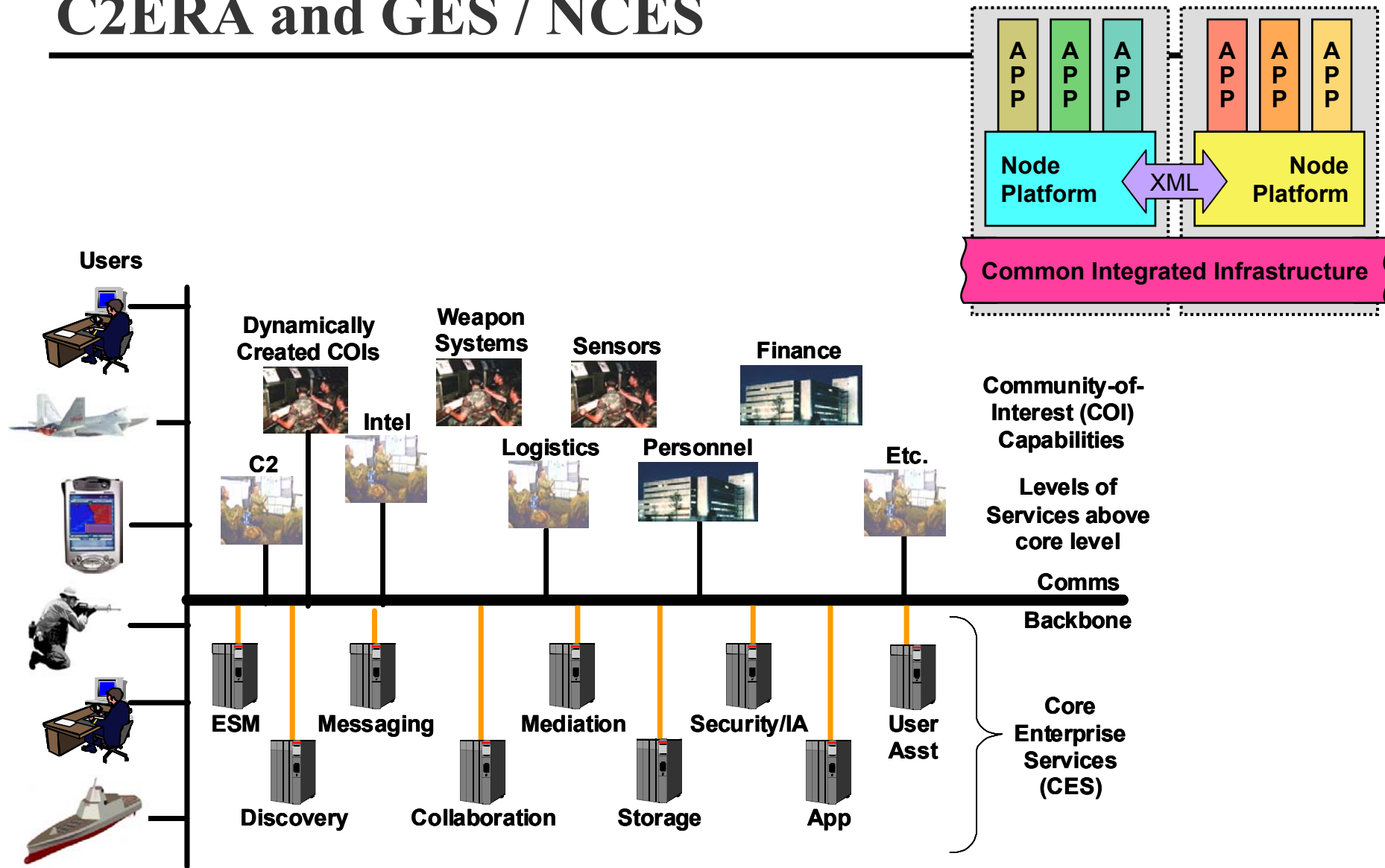C2 Node   C2 Node

- **Gather together (within each C2 Node) applications, which formerly were separate and independent**

- **Separate each application from its infrastructure… things which formerly were combined together**

- **Improved cohesion between things that should work together**

- **Reduced coupling between things that should change independently**

- **Better functionality and flexibility**

New technology supports these improvements

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C2ERA and GES / NCES

Global Information Grid (GIG) Enterprise Services (GES)

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Summary

- **C2ERA makes two changes to C2 systems**
  - **Manage related applications as *C2 Nodes***
  - **Separate mission functionality from infrastructure**

- **Infrastructure separated into**
  - **Common Integrated Infrastructure (CII)
    Same for the whole enterprise**
  - **Node platforms – can be different for each C2 Node**

- **Consistent with new DoD approach**

- **Result: better functionality and flexibility**

- **Made feasible by new technology**

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